possible. But what is still more puzzling is how Prof. Carnelley succeeded in burning his fingers with the ice. Our previous knowledge would lead us to suppose that the outside surface of the block of ice was a *free surface*, and that therefore it would be impossible, however high the temperature of the inside of the block, to heat the outside above the "melting point," as we should expect the ice to melt or to sublime at the outside, and keep the temperature at 0° C.

These expectations being disappointed, we naturally look to the decreased pressure under which Prof. Carnelley's experiments were made for an explanation of this most unexpected state of matters. Now it is very evident that when dealing with pressures of about one atmosphere, and with temperatures of 120° and 180° C., that pressure, as pressure, has nothing whatever directly to do with the "melting point" of the ice. While this is the case, it is equally evident that it has a most important influence on the surroundings of the ice. At the pressure of 4·6 mm., at which the experiments were made, no water would be present, there would be nothing but ice and water-vapour. Here then appears to be the great teaching of Prof. Carnelley's experiments. *They show that the surface of ice bounded by its own vapour is not a "free surface."* This result is so very unexpected that much consideration will be necessary before we can re-arrange our ideas to meet the new facts.

We might imagine that nothing could be more free than the surface of a body bounded by nothing but its own vapour, yet Prof. Carnelley's experiments seem to say it really is not so, and not being a "*free surface*," we of course know nothing whatever of how high the temperature will require to be before the ice will melt under these conditions.

These experiments of Prof. Carnelley's are so interesting that we wait with impatience a full description of them. His results indicate something new with regard to the influence of a liquid on its melting solid. I observe that Prof. Carnelley's results are doubted by most of your correspondents, but for the present we must accept them when Prof. Carnelley distinctly states that the temperature of the ice was taken by means of a thermometer in contact with the ice. JOHN AITKEN

Darroch, Falkirk, N.B., October 30

Wire Torsion

IN the letter in NATURE, vol. xxii. p. 604, which we wrote at the request of Major Herschel, who asked for information regarding the connection between tensional and torsional strains of a brass wire, we mentioned that there were many papers scattered through the *Proceedings* of learned societies dealing with the fluidity of metals. There is one communication to which we might specially have referred, as it deals in particular with the torsional yielding of wires under tension, and this is a paper on "Torsion," by Prof. G. Wiedemann, in the *Annalen der Physik und Chemie*, No. 4, vol. vi., 1879, pp. 485-520, and of which a translation is given in the *Philosophical Magazine*, vol. ix., January 1880, pp. 1-15, and February, pp. 97-109. The first part of this paper gives a detailed account of experiments which show :—(1) That a brass wire often subjected to a particular torsion, either in one or in both directions, becomes "killed" for any less torsions, that is, follows Hooke's law for its temporary torsions; (2) that a wire under tension acquires greater torsional set from a given torsional couple than when the wire is unextended; (3) that a wire under even considerable tension may be killed by torsion in alternately opposite directions, that is, it will obey Hooke's law for any tension or torsion less than the stresses actually applied originally. Prof. Wiedemann in the second part of his paper considers the well-known "agitation effects," and enters on an explanation of the phenomenon based upon molecular allineations referring to the magnetisation theory of Weber and Kolrausch which is based on the same idea.

The strains in Prof. Wiedemann's wires were however much less than in those used in Major Herschel's experiments.

JOHN PERRY
London, November 8 W. E. AYRTON

Heat of Formation of a Compound

IN NATURE, vol. xxii. p. 608, there is a paper on "Recent Chemical Research," in which under the head of work by Thomsen the following law is enunciated :—

"The heat of formation of a compound substance is the difference between the sum of the heats of combustion of the constituent elements of the compound and the heat of combustion of the compound itself." After that it is shown that this is not the true heat of formation of the compound, as many important corrections have to be made. On referring to Berthelot's "Essai de Mécanique Chimique" I find the following :—"The heat of formation of an organic compound from its elements is the difference between the sum of the heats of total combustion of its elements and the heat of combustion of the compound with formation of identical products."

Can any of your readers inform me whether Thomsen or Berthelot first enunciated this law?

Another point is, that Berthelot apparently makes no reference to the corrections for the heat absorbed in dissociating the molecules of the elements, &c. A. P. LAURIE

Edinburgh, November 1

The Yang-tse, the Yellow River, and the Pei-ho

IN replying to the letter of your correspondent (NATURE, vol. xxii. p. 559) on the subject of my recent paper on these three rivers, I have to thank him for his very probable explanation of the excessive estimate made by Sir George Staunton of the amount of sediment discharged by the Yellow River.

The estimate given in my paper of the water-discharge of the River Plate is *ipso facto* an assumption made by Mr. George Higgin from Mr. Bateman's calculation of the minimum flow of that river, which he found to be 670,000 cubic feet per second. It might have been better, however, if I had added Mr. Higgin's qualifying remark that such an estimate of the mean volume of water was "very much under the mark" (NATURE, vol. xix. p. 555).

The anomaly of the surface current varying in velocity with the same average depth of water has not been unnoticed by myself, though I am unable to give a satisfactory explanation of the difficulty. H. B. GUPPY

Woodlane, Falmouth, November 6

The Thresher

WHAT is the "thresher"? It is generally assumed to be the fox-shark (*Alopias vulpes*), but in a recent number of *Land and Water*—which I have only just seen—Mr. Frank Buckland says that he believes it to be "the gladiator dolphin or sword grampus" (*Orca gladiator*). This he infers from a drawing of Lord A. Campbell's, of which he gives a copy. The tail, he says, is not that of the fox-shark. But as it is heterocercal it cannot be that of a grampus or any other Cetacean. Whatever it is I suppose that there is no doubt that it throws itself out of the water ("high as the masthead" [of a trawler] one of Mr. Buckland's correspondents avers). Does it do so more than once? Once, many years ago, between Sydney and New Zealand, I saw, what they said was a fight between a thresher and a whale, but there was nothing to be seen beyond a splashing of the water. Last year off Lisbon I witnessed a similar event. Does the sword-fish also attack the whale? Lord A. Campbell, in the letter accompanying his drawing, estimated the length of *his* thresher at "upwards of thirty feet;" this is twice the length given by Yarrell. FRANCIS P. PASCOE

October 30

Since the above was written I see that Dr. Günther, in his new work on Fishes, says: "Statements that it (the fox-shark) has been seen to attack whales and other large cetaceans rest upon erroneous observations" (p. 322).

"STUDENT" should refer to Newcomb's "Popular Astronomy" with respect to the larger telescopes. For results he must refer to the publications of the Royal and Astronomical Societies, the Washington Observatory, &c.

PAUL LAFARGUE.—We regret we have no further details on the labours of the U.S. Fish Commission in increasing the food supply of the country.

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION

I.

THE sagacious founders of the Zoological Society of London made it a special rule that no dividends or gifts of any kind should be distributed amongst the

members. On the contrary, every Fellow has to contribute an annual sum towards the maintenance of the Society's establishment, unless he prefers to pay a life-composition in lieu thereof. Moreover, the Society are so fortunate as to be unencumbered by borrowed capital. They have consequently no burden in the shape of interest to be provided for. It follows that after putting aside from their income a sum sufficient to meet the annual expenditure, they are able to devote the surplus to new buildings in the Gardens, and to the acquisition of new and rare subjects for the menagerie. While the supply of lions, tigers, elephants, and other well-known animals must always be kept up for the delectation of the ordinary public, and for the maintenance of the best possible living series of animals, it is also thus in their power to acquire animals of specially scientific value, in which the casual observer would take little interest, and which would, therefore, be quite ineligible except in a scientific point of view. This course of action has been adopted for many years, more especially since the foundation of the office of "Prosector" to the Society. For these special acquisitions not only delight the eyes of the intellectual observer while they live, but furnish the prosector with subjects for his studies when dead. Those who are acquainted with the *Proceedings* and *Transactions* of the Zoological Society of London will be well aware of the amount of work that has thus been accomplished as regards the anatomy of many of the rarer birds and mammals.

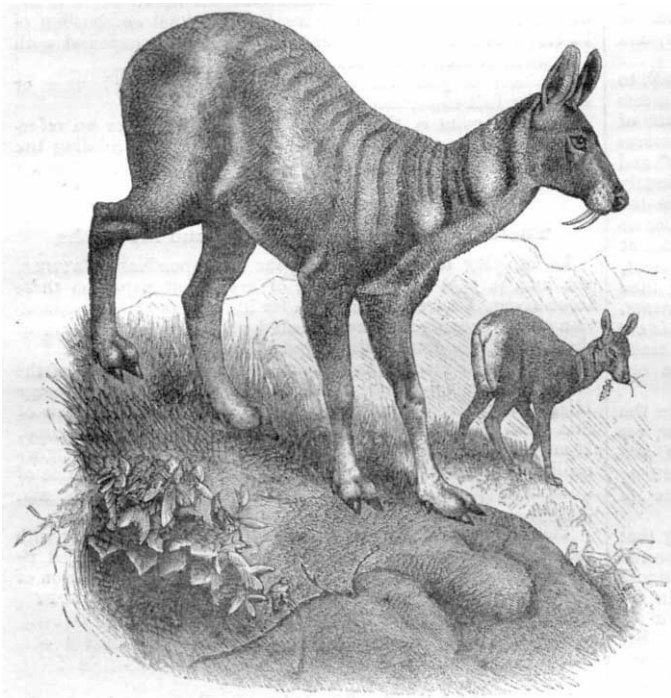

FIG. 1.—The Musk-deer (*Moschus moschiferus*). (From a drawing by Mr. J. Wolf from nature.)

It is, however, by no means by purchase only that rare animals are added to the Zoological Society's collection. Numerous friends and correspondents in almost every corner of the earth are in constant communication with the Secretary of the Society, and are ever endeavouring to obtain specimens that may be acceptable to the collection. In fact the donations have of late years become so numerous that they have not unfrequently rivalled in number and interest the objects acquired by purchase. Taking the acquisitions from these two sources together, there are always a considerable number of objects in the Society's collection that specially invite the attention of the observant naturalist. Amongst these rarities there are at the present moment the following, of which illustrations are given, drawn upon wood by Mr. J. Smit, an artist constantly employed by the Zoological Society.

1. The musk-deer (*Moschus moschiferus*) was well known to the older writers on zoology as the animal that has from long periods of time supplied the "musk" of commerce. This scent is still much in vogue in the East, but in Western Europe has been long superseded by more refined perfumes, though it may be remarked that one of the fashionable dealers in Bond Street still keeps a stuffed musk-deer in his window, and is doubtless ready to supply the product in question.

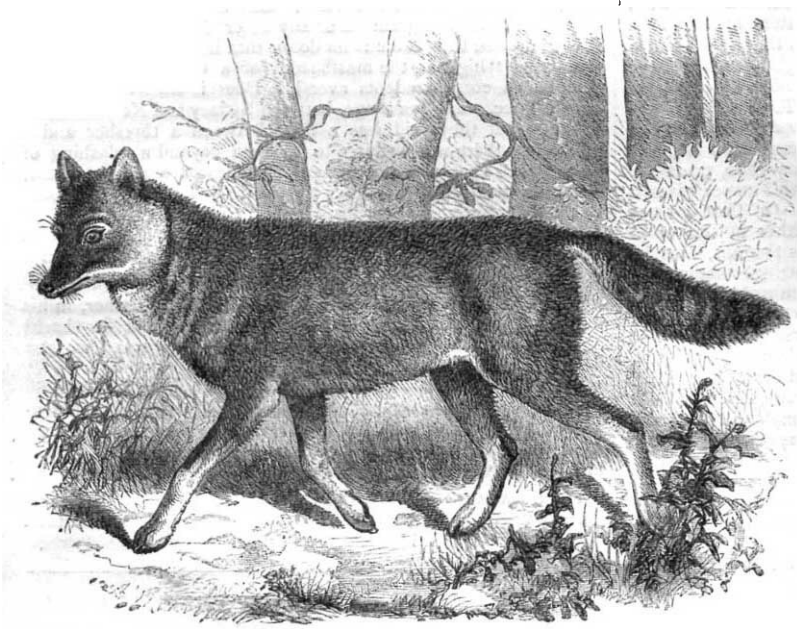

FIG. 2.—The Japanese Wolf (*Canis hodophylax*).

The musk-deer was until recently usually associated with another group of mammals to which it has really very little affinity. Dr. Gray and other systematists united it with the Chevrotains (*Tragulus*) of India and tropical Africa —a group of ruminants remarkable for their small size and hornless heads, and presenting somewhat of the appearance of diminutive antelopes. M. Alphonse Milne-Edwards of Paris was, we believe, the first naturalist to show that this allocation was unnatural. In his excellent essay on the Chevrotains, published in 1864, M. Milne-Edwards proved conclusively that these little-understood animals constitute a peculiar family of ungulates quite distinct from either the Bovidæ or Cervidæ, and in fact in some respects approaching more nearly to the pigs (Suidæ). The correctness of these observations has been since fully demonstrated by Prof. Flower, Mr. Garrod, and other systematists.

The musk-deer therefore remains unique in its own group, and constitutes a special division of the Cervidæ

or deer-family, remarkable for its absence of antlers in both sexes, the extraordinary prominence of the canine teeth (well shown in the illustration), the musk-producing organ, and other peculiarities.

It is to the great exertions of Sir Richard Pollock, K.C.S.I., lately Commissioner at Peshawur, that the Zoological Society are indebted for their living examples of the musk-deer, the only specimens, it is believed, that have ever been brought to Europe in captivity. A female of this animal was first received from Sir Richard Pollock in 1869. Although it did not live long in the Gardens, it gave Prof. Flower an opportunity of preparing a most valuable paper on its anatomy[1] The same generous donor presented in 1877 a pair of this scarce animal, obtained from the Cashmere Hills, of which the male, now in excellent condition and fully adult, still survives, and is the subject of the accompanying illustration.

The musk-deer is found throughout the mountainous districts of Central and Eastern Asia, ranging, as the recent Russian explorers have shown, into Amoorland. Southwards it extends into the Himalayas, but is here, as Jerdon tells us, only met with at great elevations, rarely descending in summer below a height of 8000 feet, and extending as high as the upper limits of the forests.

Hodgson says that the musk-deer is "solitary, living in retired spots near rocks or in the depths of the forests: they leap well, but cannot climb nor descend slopes well. They rut in winter, and produce one or two young, usually in the cleft of a rock. In six weeks the young can shift for themselves, and are driven off by the mother."

The musk-deer, as stated by Jerdon, is wonderfully sure-footed, and over rocky and precipitous ground perhaps has no equal. It appears to eat chiefly grasses and lichens. If twins are produced the two are kept apart, it being very solitary in its habits, even in infancy. The musk is milky for the first year or two, afterwards granular. The dung of the males smells of musk, but the body does not, and females do not smell of it in the slightest degree. The flesh is dark red, and the young is considered to afford the best venison in India.

The musk-deer is much sought after by the hunter for its musk, many being shot and snared annually. A good musk-pod is valued at from ten to fifteen rupees. The musk as sold is often much adulterated with blood, liver, &c. One ounce is about the average produce of the pod.

2. The species of the genus *Canis* known as wolves—that is *Canis lupus* and its representative forms—are widely spread over the northern hemisphere, extending in the Old World as far south as Abyssinia (*Canis simensis*) and India (*Canis pallipes*). In North America the larger *Canis occidentalis* take their place in the Arctic regions and Rocky Mountains, but as it goes south, gradually gives place to the very distinct prairie-wolf (*Canis latrans*), which seems to range as far down as the Central American Isthmus.

The existence of a true wolf in Japan has been known to us since 1847 from its description and figure in Temminck and Siebold's "Fauna Japonica," under the name *Canis hodophylax*. But this animal has been very little known in Europe except from the specimens in the Leyden Museum, and as it is altogether omitted in Dr. Gray's Catalogue of the Carnivores, appears to be not even represented in the well-stored galleries of the British Museum. It is to an active correspondent in Japan—Mr. H. Heywood Jones—that the Zoological Society are indebted for their unique specimens of this scarce carnivore, which is now very difficult to be procured, having been driven into the recesses of the wooded mountains.

In general form and proportions the Japanese wolf much resembles its well-known congener of Europe, but is of inferior size and more slender make. According to Siebold its native name is "Jamainu."

3. The Tufted Umbrette (*Scopus umbretta*) or "Hammerkop" of the Cape Colonists, is a well-known bird both to natives and travellers all over Central and Southern Africa, but in Europe has only hitherto been recognised as a somewhat scarce object to be found in the principal museums. The example now in the Zoological Society's Gardens, which was acquired a few weeks ago by purchase from a dealer in Liverpool, is, it is believed, the only living specimen yet brought to Europe. The umbrette has been usually placed by systematists among the storks, and by Prof Reinhardt was supposed to be the nearest ally of the *Balæniceps rex* (without doubt a Ciconiine form). But those who have studied its nimble gait and active habits, as shown in life, will not readily agree to this opinion. Nothing can well be more different from the staid, stolid demeanour of the stork than the lively action of the umbrette, which rather reminds one of a curlew or sand-piper. It is probable, however, that its real place will be found to be amongst the spoonbills and ibises (Plataleidæ), a group usually associated with the storks, although it must be recollected that the late Prof. Garrod maintained that (as "Schizorhinæ") the Plataleidæ would be better placed with the Limicolæ. When the present specimen dies the question of its position will be quickly decided by the Society's prosector,

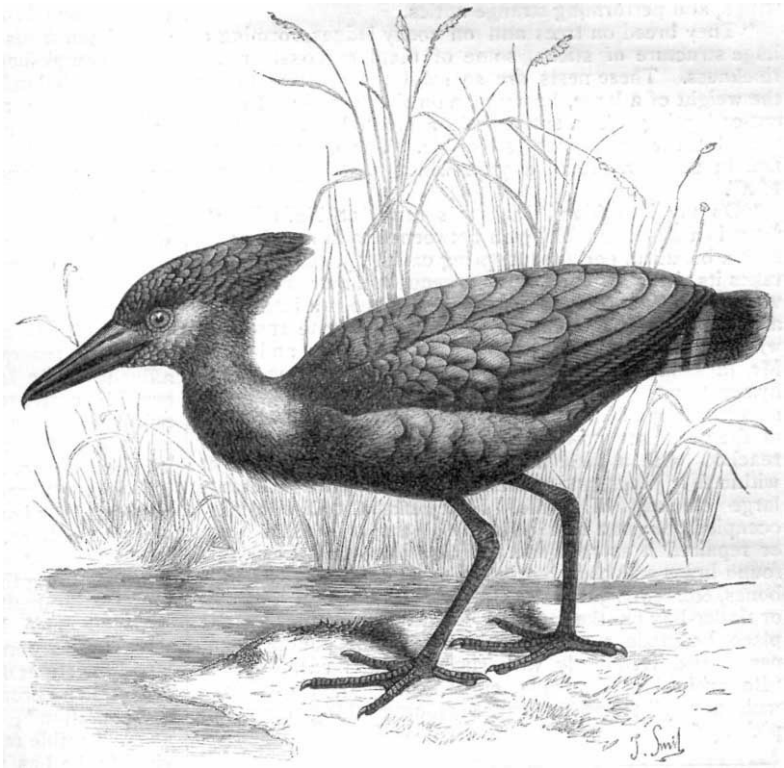

FIG. 3.—The Tufted Umbrette (*Scopus umbretta*).

[1] "On the Structure and Affinities of the Musk-Deer (*Moschus moschiferus*, Linn.)," by William Henry Flower, F.R.S., V.P.Z.S.—P.Z.S., 1875, p. 159.

but long may we wait, it is to be hoped, before this event shall happen.

Of the curious nesting habits of *Scopus* we have excellent accounts from Brehm, Heuglin, and other naturalists who have visited the Upper Nile. But one of our own countrymen, a not less active or experienced observer—has likewise written a most interesting account of this bird's economy, and we cannot do better than transcribe a part of it.

"The *Hammerkop* (literally hammerhead)," says Mr. Layard in "The Birds of South Africa," "is found throughout the Colony and all the way to the Zambezi, frequenting ponds, marshes, rivers, and lakes. It is a strange, weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fishes, &c. At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics.

"They breed on trees and on rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing. The entrance is a small hole, generally placed in the most inaccessible side. The eggs, three to five in number, are of a pure white, axis 1″ 9‴; diam. 1″ 4‴.

"On my late friend Jackson's farm, at Nel's Poort, there is a singular rocky glen between two hills. In this spot a beautiful permanent spring called 'Jackalsfontein' takes its rise. Of course, in consequence, there are a few wild almond and other trees, and the place is a little oasis amid the barren mountains. It is a favourite resort of wild animals, hyænas, leopards, jackals, &c., and here Mr. Jackson has constructed one of his most successful hyæna-traps. On the ledges of the rocks in this secluded spot a colony of Hammerkops have built for years. Some of the nests are quite inaccessible, while others can be reached with a little trouble. I counted six or eight within fifty yards, and some of them contained at least a large cartload of sticks. Mr. Jackson told me they occupied the same nest year after year, and added to it or repaired it as required. About some that I visited I found brass and bone buttons, bits of crockery, bleached bones, &c. Mr. Jackson said if a 'Tottie' lost his knife or tinder-box on the farm, or within some miles of the place, he made a point of examining the hammerkops' nests, and frequently with success, the birds, like the 'Bowerbird' of Australia, embellishing their dwellings with any glittering or bright-coloured thing they can pick up."

A SUCCESSFUL AFRICAN EXPEDITION

AFRICA is overrun with explorers of all nationalities. Too often of late have we had to read of failures, of abortive attempts on the part of expensively-equipped expeditions to reach the field of their work, or of deaths by fever or assassination after the first difficulties were overcome. In spite of all, however, the unprecedented activity of recent years in this favourite field of exploration has pretty well filled up, with the leading features at least, that great blank space in the heart of the continent which in the rude maps of our schoolboy days was marked "unexplored." In the very centre of that space there is still however a blank, giving ample scope for work for the numerous Belgian expeditions that have hitherto done so little. It was to fill up this blank to some extent that the Geographical Society, about two years ago, obtained subscriptions to send out an expedition under young Keith Johnston, who had inherited an enthusiasm for geographical work quite worthy of the name he bore. As his subordinate and as geologist to the expedition, the Society appointed another young Scotchman, Mr. Joseph Thomson, a pupil of Prof. Geikie, who recommended him to the Geographical Society. To him, we grieve to say, it has been left to tell the story of the expedition, which he did, and did well, on Monday night at the opening meeting of the Geographical Society. This expedition is remarkable in many respects, in some points more remarkable than any other African expedition that we know of. The outline of its story is soon told. With 150 of the best men that could be found in and around Zanzibar Keith Johnston left that place in May, 1879, and striking at once to the south-west, made for the north end of Lake Nyassa, which was the real starting-point for fresh work. Little more than a month after the start, young Johnston, who seemed to have the nerve and stamina of an athlete, succumbed to the malarious influences of the coast region, and was buried by his companion at Behobeho, to the north of the Lufiji river. Mr. Thomson, inexperienced youth of twenty-two though he was, was equal to the emergency. With admirable tact and nerve he took his place as the sole leader of the expedition, and accomplished even more than the work which the Society had chalked out for it. By an unexplored route, through barren wastes and over lofty mountains, through the sneaking Wakhutu and the warlike Mahenge, he and his followers made their way till their eyes were gladdened and their weary spirits refreshed by the sight of the waters of Nyassa. Thence, after brief rest, they resumed their march over the lofty and undulating plateau, which they found occupied the region between the north end of Nyassa and the south shore of Tanganyika. Leaving here the bulk of his followers, Mr. Thomson, with a handful of men, trudged his way over the rugged western shores of Lake Tanganyika, to visit the Lukuga and settle the question whether it was an outlet or an affluent of the lake, a question, which, one would think, could be easily solved, but on which Stanley and Cameron published diametrically opposite statements. After visiting the missionary station near the mouth of the river, and running across to Ujiji, Mr. Thomson returned to the Lukuga and traced it for some miles of its downward course. After barely escaping from the murderous Warua with their lives, the party sailed down the lake, and rejoining their companions made the return journey to Zanzibar along the usual caravan route with unprecedented rapidity, in about a year after the expedition set out under their late chief. Mr. Thomson declared with just pride that all this was accomplished without the shedding of a drop of blood for either offensive or defensive purposes; with one exception he brought all his men back "in the best of health and condition"; he has collected certain information about a considerable region which no white man had previously visited; he has solved one of the few remaining great problems of African geography; and he has located with certainty a great salt lake (Hikwa) whose existence previously had only been based on native rumour. Mr. Thomson is a trained geologist, and as such he has doubtless seen more than almost any previous explorer. He tells us of the metamorphic schists and gneiss which compose the mountains of the great central plateau; of the many extinct volcanic cones that lie around the north-west end of Lake Nyassa, and of the metamorphic clay slates, felspathic rocks and volcanic porphyries and tuffs that look down on the lake from the north and north-east. His further geological insight may dispel some of the illusions that seem to be abroad as to the abounding wealth of the African interior. Much of the country between the coast and Nyassa is barren waste; and the chief characteristic of the region between Nyassa and Tanganyika he found to be "utter barrenness and the absence of anything worth trading for." Instead of the mountains of iron and the miles of surface coal, nowhere did he see a single metal in a form which a white man would for a moment look at as a profitable or workable speculation; there is very little more iron, he